PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

August D'ALIGNY et al.

Serial No. (unknown)

Filed herewith

DEVICE FOR THE THREE-DIMENSIONAL RECORDING OF A SCENE USING LASER EMISSION

PRELIMINARY AMENDMENT

Commissioner for Patents

Washington, D.C. 20231

Sir:

Prior to calculation of the filing fee, please amend the above-identified application as follows:

IN THE CLAIMS:

Amend claim 3 as follows:

--3. (Amended) Three-dimensional recording device according to Claim 1, characterized in that the second measuring means comprise, placed between the laser emitter (20) and the splitter plate (32), a prismatic plate (24) for compensating for the deformations of the wave surface of the emitted beam which are caused by the off-axis spherical mirror (38).-

Amend claim 5 as follows:

--5. (Amended) Three-dimensional recording device according to claim 1, characterized in that the divergent optical system (50) comprises a divergent lens placed in the path of the backscattered beam between the splitter plate (32) and the photosensitive receiver (46).--

Amend claim 6 as follows:

--6. (Amended) Three-dimensional recording device according to claim 1, characterized in that the splitter plate (32) has a semireflective patch (34) for reducing the dynamic range of the power of the laser beam backscattered by the scene (4) and received by the photosensitive receiver (46).--

Amend claim 7 as follows:

--7. (Amended) Three-dimensional recording device according to claim 1, characterized in that the photosensitive receiver (46) comprises an avalanche photodiode and in that this photodiode is combined with temperature compensation means (330).--

Amend claim 9 as follows:

--9. (Amended) Three-dimensional recording device according to claim 1, characterized in that the scanning means (14, 42, 200, 202, 204, 206, 210, 212, 224, 226) comprise a plane mirror (42) and means (14, 200, 202, 206, 224, 226) for controlling the position of this mirror

about each of the said first and second rotation axes (16, 44) of the said scanning means.--

Amend claim 13 as follows:

--13. (Amended) Three-dimensional recording device according to claim 9, characterized in that the second rotation axis (44) is an elevation rotation axis and in that the means (224, 226) for controlling the position about this axis include a drive shaft (224), the axis of which is fixed with respect to the platform (14), connecting the mirror (42) to a galvanometric scanner (226) driving the mirror (42) in rotation about the said second axis (44).--

Amend claim 14 as follows:

--14. (Amended) Three-dimensional recording device according to claim 10, characterized in that the first measuring means (214, 226) comprise an annular incremental optical encoder (214) for measuring the relative bearing orientation of the beam, the encoder being carried by the platform (14).--

Amend claim 16 as follows:

--16. (Amended) Three-dimensional recording device according to claim 1, characterized in that it furthermore includes a unit (22) for automatically focussing the laser beam emitted by the laser emitter (20)

and means (96, 98, 100, 108) for fixing the laser emitter (20) to the unit (22).--

Amend claim 18 as follows:

--18. (Amended) Three-dimensional recording device according to claim 16, characterized in that the unit (22) for automatically focussing the laser beam comprises at least one divergent lens (60, 62) placed on the emission axis (26) of the laser beam, a convergent lens (64) also placed on the emission axis (26) and means (78, 118, 120, 122, 124, 126, 128, 130) for the relative travel of the convergent lens (64) and of the divergent lens (60, 62) along the emission axis (26).--

Amend claim 21 as follows:

--21. (Amended) Three-dimensional recording device according to Claim 19, characterized in that the means (118, 124, 126, 128, 130) for actuating the flexible membrane (120) comprise means (126) for comparing the detected position of the convergent lens (64) with the desired position of the convergent lens (64) along the emission axis (26), including means for actuating the current generator (124) depending on this difference.--

Amend claim 22 as follows:

--22. (Amended) Three-dimensional recording device according to claim 16, characterized in that the automatic focussing unit (22) includes optical means (128,

130) for detecting the position of the convergent lens (64) along the emission axis (26).--

Amend claim 23 as follows:

--23. (Amended) Three-dimensional recording device according to claim 9, characterized in that it includes means of adjustment (228) of the means for controlling the position of the galvanometer mirror (42) about the elevation rotation axis (44) and means of adjustment (229) of the axis (36), along which the laser beam is received, about the bearing rotation axis (16).--

Amend claim 26 as follows:

--26. (Amended) Three-dimensional recording device according to any one of Claims 1 to 25, characterized in that it furthermore includes means (300) for reducing the dynamic range of the signal delivered as output by the photosensitive receiver (46).--

Amend claim 28 as follows:

--28. (Amended) Three-dimensional recording device according to claim 1, characterized in that the second measuring means (24, 28, 32, 34, 48, 314) for measuring the distance between the device and the spot comprise an integrated circuit (314) for measuring the "time of flight" of the laser beam.--

Amend claim 29 as follows:

--29. (Amended) Method for designating an area of interest on a scene (4) carried out in a three-dimensional recording device according to claim 1, comprising the following steps:

- three-dimensional recording of a cloud of points of the scene (4);

- storage (12) of the coordinates of the cloud of points recorded;

- modelling and/or display of the said cloud of points;

characterized in that it furthermore includes the following steps:

- selection of a subcloud of at least one point in the said cloud, defining the said area of interest; and

- control of the scanning means (14, 42, 200, 202, 204, 206, 210, 212, 224, 226) and of the emitter (20) so that the spot (52) created on the scene (4) by the laser beam designates in succession at least some of the points of the selected subcloud corresponding to the said area of interest.--

R E M A R K S

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE".

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

The claims have been amended as follows:

3. (Amended) Three-dimensional recording device according to Claim 1~~ or 2~~, characterized in that the second measuring means comprise, placed between the laser emitter (20) and the splitter plate (32), a prismatic plate (24) for compensating for the deformations of the wave surface of the emitted beam which are caused by the off-axis spherical mirror (38).

5. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1~~ to 4~~, characterized in that the divergent optical system (50) comprises a divergent lens placed in the path of the backscattered beam between the splitter plate (32) and the photosensitive receiver (46).

6. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1~~ to 5~~, characterized in that the splitter plate (32) has a semireflective patch (34) for reducing the dynamic range of the power of the laser beam backscattered by the scene (4) and received by the photosensitive receiver (46).

7. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1~~ to 6~~, characterized in that the photosensitive receiver (46) comprises an

avalanche photodiode and in that this photodiode is combined with temperature compensation means (330).

9. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1 ~~to 8~~, characterized in that the scanning means (14, 42, 200, 202, 204, 206, 210, 212, 224, 226) comprise a plane mirror (42) and means (14, 200, 202, 206, 224, 226) for controlling the position of this mirror about each of the said first and second rotation axes (16, 44) of the said scanning means.

13. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 9 ~~to 12~~, characterized in that the second rotation axis (44) is an elevation rotation axis and in that the means (224, 226) for controlling the position about this axis include a drive shaft (224), the axis of which is fixed with respect to the platform (14), connecting the mirror (42) to a galvanometric scanner (226) driving the mirror (42) in rotation about the said second axis (44).

14. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 10 ~~to 13~~, characterized in that the first measuring means (214, 226) comprise an annular incremental optical encoder (214) for measuring the relative bearing orientation of the beam, the encoder being carried by the platform (14).

16. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1~~ to 15~~, characterized in that it furthermore includes a unit (22) for automatically focussing the laser beam emitted by the laser emitter (20) and means (96, 98, 100, 108) for fixing the laser emitter (20) to the unit (22).

18. (Amended) Three-dimensional recording device according to ~~either of Claims~~claim 16~~ and 17~~, characterized in that the unit (22) for automatically focussing the laser beam comprises at least one divergent lens (60, 62) placed on the emission axis (26) of the laser beam, a convergent lens (64) also placed on the emission axis (26) and means (78, 118, 120, 122, 124, 126, 128, 130) for the relative travel of the convergent lens (64) and of the divergent lens (60, 62) along the emission axis (26).

21. (Amended) Three-dimensional recording device according to Claim 19~~ or 20~~, characterized in that the means (118, 124, 126, 128, 130) for actuating the flexible membrane (120) comprise means (126) for comparing the detected position of the convergent lens (64) with the desired position of the convergent lens (64) along the emission axis (26), including means for actuating the current generator (124) depending on this difference.

22. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 16 ~~to 21~~, characterized in that the automatic focussing unit (22) includes optical means (128, 130) for detecting the position of the convergent lens (64) along the emission axis (26).

23. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 9 ~~to 22~~, characterized in that it includes means of adjustment (228) of the means for controlling the position of the galvanometer mirror (42) about the elevation rotation axis (44) and means of adjustment (229) of the axis (36), along which the laser beam is received, about the bearing rotation axis (16).

26. (Amended) Three-dimensional recording device according to any one of Claims 1 to 25, characterized in that it furthermore includes means (300) for reducing the dynamic range of the signal delivered as output by the photosensitive receiver (46).

28. (Amended) Three-dimensional recording device according to ~~any one of Claims~~claim 1 ~~to 27~~, characterized in that the second measuring means (24, 28, 32, 34, 48, 314) for measuring the distance between the device and the spot comprise an integrated circuit (314) for measuring the "time of flight" of the laser beam.

29. (Amended) Method for designating an area of interest on a scene (4) carried out in a three-dimensional recording device according to ~~any one of Claims~~claim 1 ~~to 28~~, comprising the following steps:

- three-dimensional recording of a cloud of points of the scene (4);
- storage (12) of the coordinates of the cloud of points recorded;
- modelling and/or display of the said cloud of points;

characterized in that it furthermore includes the following steps:

- selection of a subcloud of at least one point in the said cloud, defining the said area of interest; and
- control of the scanning means (14, 42, 200, 202, 204, 206, 210, 212, 224, 226) and of the emitter (20) so that the spot (52) created on the scene (4) by the laser beam designates in succession at least some of the points of the selected subcloud corresponding to the said area of interest.

ABSTRACT OF THE DISCLOSURE

This device for the three-dimensional recording of a scene (4) comprises a laser emitter (20), elements for scanning along two rotation axes (16, 44) in order to scan the scene using a laser beam emitted by the laser emitter (20), a photosensitive receiver (46) for receiving an image of a spot (52) created by the laser beam on the scene (4), element (38, 50) for focussing the laser beam backscattered by the scene (4) towards the photosensitive receiver (46), first measuring element for measuring the orientation of the beam leaving the scanning element and second measuring element for measuring the distance between the device and the spot by laser telemetry.